

JCTVC-I0188: Use of chroma phase in LM mode

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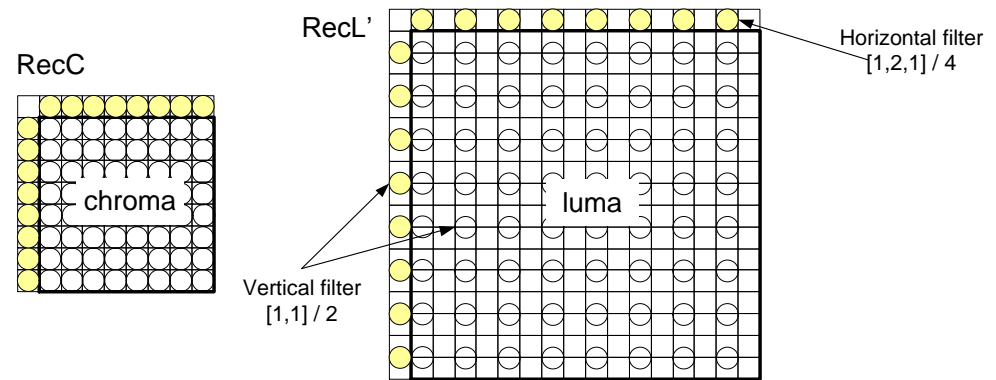
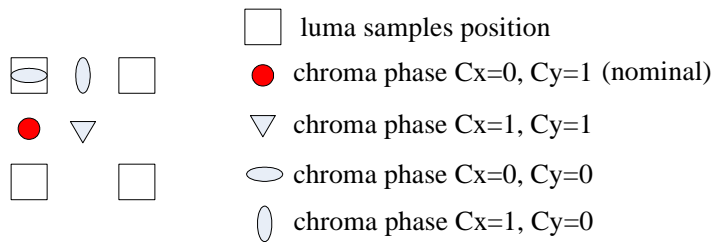
Chroma phase in current HM design

■ LM mode explicitly links chroma samples to luma samples

- chroma samples position (chroma phase) related to luma samples should be taken into account

■ Definition for 4:2:0:

- Cx,Cy indicate the grid position
- Nominal case: Cx=0,Cy=1



■ In current HM design

- Syntax element chroma_format_idc indicating the chroma format (i.e. YUV4:2:0, ...)
- Left samples: $\text{RecL}'[-1,y] = (\text{RecL}[-1,2y] + \text{RecL}[-1,2y+1]) \gg 1$
- Inner samples: $\text{RecL}'[x,y] = (\text{RecL}[2x,2y] + \text{RecL}[2x,2y+1]) \gg 1$
- Top samples: $\text{RecL}'[x,-1] = (\text{RecL}[2x-1,-1] + 2\text{RecL}[2x,-1] + \text{RecL}[2x+1,-1] + 2) \gg 2$

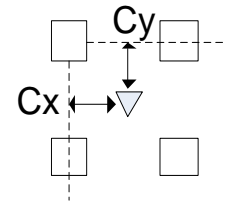
Proposal : generalize LM mode for other chroma phase

■ SPS/PPS syntax change: signal horizontal/vertical chroma phase

- Possibly insert other information
 - Such as those defined in AVC Video usability information, resolution ratio luma/chroma, progressive/interlaced ...

■ New RecL' samples interpolation depending on the chroma phase

- several filters experimented – following filters are recommended



□ luma samples
▽ chroma samples

Chroma format	Filter	(Cx,Cy)	Top	Left	Inner
4:2:0	0	(0, 0)	[1,2,1]/4 horiz	[1,2,1]/4 vertic	[1,2,1]/4 horiz
	1	(0.5, 0)	[1,1]/2 horiz	[1,2,1]/4 vertic	[1,1]/2 horiz
	2 (default HM)	(0, 0.5)	[1,2,1]/4 horiz	[1,1]/2 vertic	[1,1]/2 vertic
	3	(0.5, 0.5)	[1,1]/2 horiz	[1,1]/2 vertic	$\begin{bmatrix} 1,1 \\ 1,1 \end{bmatrix} / 4$ bidim
4:2:2	0	(0, 0)	[1,2,1]/4 horiz	No filt	[1,2,1]/4 horiz
	1	(0.5, 0)	[1,1]/2 horiz	No filt	[1,1]/2 horiz

Syntax

	Descriptor
seq_parameter_set_rbsp() {	
profile_idc	u(8)
reserved_zero_8bits /* equal to 0 */	u(8)
level_idc	u(8)
seq_parameter_set_id	ue(v)
chroma_format_idc	ue(v)
if(chroma_format_idc == 1 chroma_format_idc == 2) {	
chroma_phase_x	u(1)
}	
if(chroma_format_idc == 1) {	
chroma_phase_y	u(1)
}	
max_temporal_layers_minus1	u(3)
...	
rbsp_trailing_bits()	
}	

Evaluation

- 2 sets of 4:4:4 RGB sequences considered, converted to 4:4:4 YUV
 - Class P: 1080p sequences used for the AVC professional extension
 - Class S: 2 1080p sequences, 2 2160p (3940x2160) sequences from SVT
- Each sequence converted into different YUV 4:2:0 versions, corresponding to different horizontal/vertical chroma phases
 - Using non-normative downsampling filters from JSVM
- Conversion tools provided in H0177
- Modified HM provided in current contribution (I0188)

Results

■ Previous results in HM5

		Reference HM5_V0: Cx=0, Cy=0.5									
Phase of input sequences		HM_V1 Cx=0, Cy=0			HM_V2 Cx=0.5, Cy=0			HM_V3 Cx=0.5, Cy=0.5			
Cx	Cy	Y	U	V	Y	U	V	Y	U	V	Best version
0	0	-0.1	-1.1	-1.5	0.0	0.3	0.3	0.1	1.5	1.0	HM_V1
0.25	0	-0.1	-1.4	-1.5	0.0	-1.1	-1.4	0.0	-0.3	0.0	HM_V1
0.5	0	-0.1	-1.3	-1.2	-0.1	-2.8	-2.7	-0.1	-2.0	-1.4	HM_V2
0.75	0	-0.1	-1.2	-1.0	-0.2	-4.2	-3.5	-0.2	-3.4	-2.3	HM_V2
0	0.5	0.3	4.9	2.6	0.4	7.3	3.8	0.1	1.5	1.4	HM_V0
0.25	0.5	0.3	5.0	2.6	0.3	5.2	2.6	0.0	-0.6	-0.2	HM_V3
0.5	0.5	0.3	4.8	2.5	0.2	3.0	1.1	-0.1	-2.6	-1.9	HM_V3
0.75	0.5	0.3	4.2	2.1	0.2	0.9	-0.2	-0.2	-4.2	-2.8	HM_V3

■ Similar results in HM6

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Cx=0,Cy=0	-0.1%	-1.5%	-2.0%	-0.1%	-1.5%	-1.7%
Cx=0.5,Cy=0	-0.1%	-2.4%	-2.8%	-0.1%	-2.4%	-2.8%
Cx=0.5,Cy=0.5	-0.1%	-2.2%	-2.3%	-0.1%	-1.3%	-1.5%

Conclusions

- Natural extension of LM mode to take into account chroma phase
 - Insert chroma format information signaling in SPS/PPS
 - Adapt Luma samples interpolation based on these chroma format information
 - Current proposal handles 4:2:0 content
 - Can be generalized to other formats (4:2:2, interlaced with $\frac{1}{4}$ chroma phase)
 - Chroma Gain using the right filters observed in all tested cases (up to -0.2% Y, -4.2% U, -3.5% V)